

NOTES ON THE LIFE-HISTORY AND HABITS OF
MELITTOBIA CHALYBII ASHMEAD.
(CHALCIDOIDEA: ELACHERTIDÆ)

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During the winter of 1926 several generations of *Melittobia chalybii* were reared in the laboratory at Vernon. The chalcids were given to the writer by A. A. Dennys of the Dominion Entomological Branch, who had reared them from the mud cell of a potter-wasp (*Eumenes fraterna* Say.). The adults from the potter-wasp cell were supplied with grubs of the mud-wasp (*Sceliphron cementarius* Drury), which were easy to obtain during the winter. Mud-wasp grubs proved excellent material for rearing the chalcids and, owing to the large size of the former, hundreds of the parasites were reared upon one grub. Specimens of this chalcid were sent to specialists of the United States National Museum, who identified them as the above species. The genus *Melittobia* belongs to the family Elachertidæ, superfamily Chalcidoidea (Chalcid-flies), order Hymenoptera.

Various species of *Melittobia* have been reared from the nests of many genera of wild bees such as *Anthophora*, *Osmia*, *Stelis*, *Anthidium*, *Bremus*, *Odynerus*, *Vespula*, *Leucopsis*, *Ceratina*, *Megachile* and others, as well as from the wasps *Eumenes* and *Sceliphron*.

Method of Study: The chalcids were reared in small glass dishes, one inch in diameter, covered with a piece of glass. These glass dishes were placed in a larger glass-topped box and kept in the warmth of the laboratory.

Each little dish was considered as a separate experiment and daily observations were carefully tabulated. It is not the intention of the writer to give these various tabulations in this paper, but merely a brief account of the life-history and habits compiled from notes and tabulations. This artificial method of rearing, while enabling quite satisfactory observations to be made on certain phases of the life-history of the insect, does not, by any means, enable one to give an accurate and complete account as it would occur in nature.

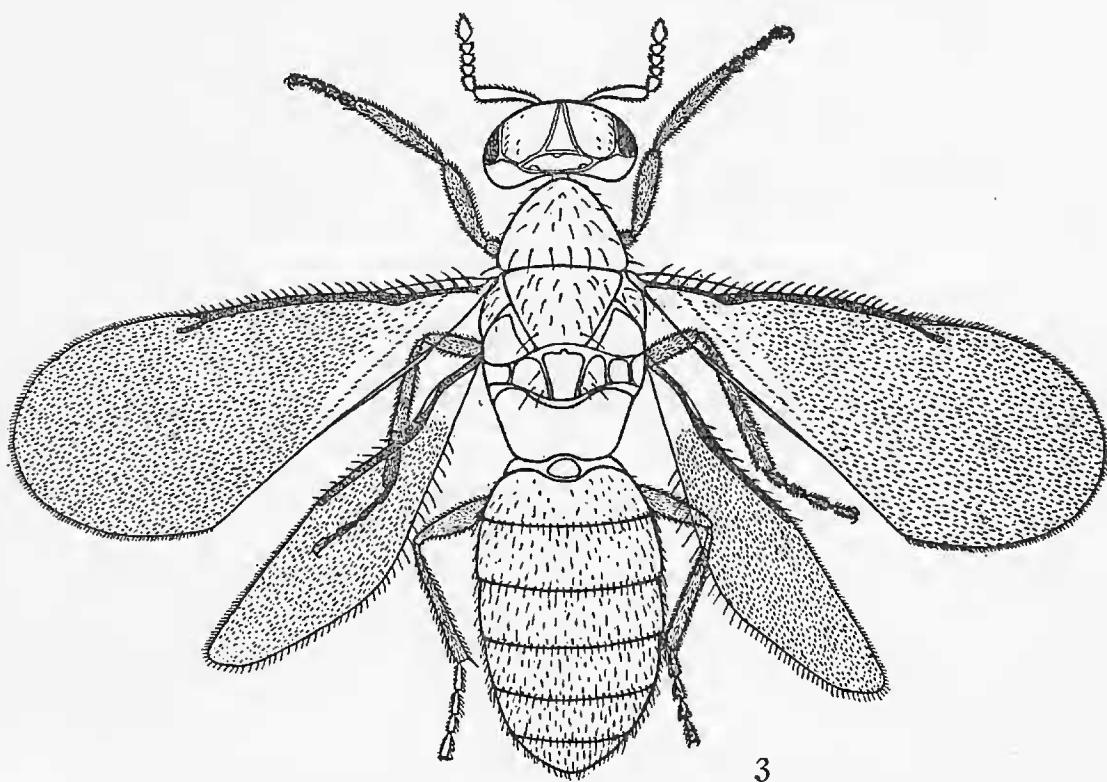
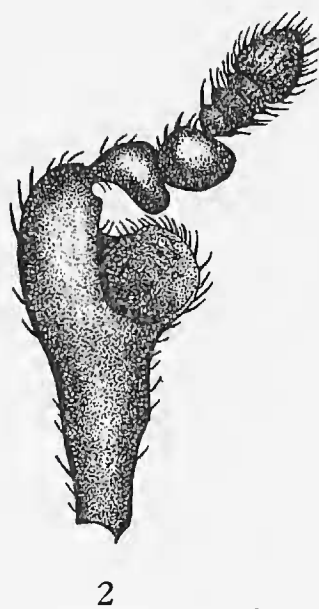
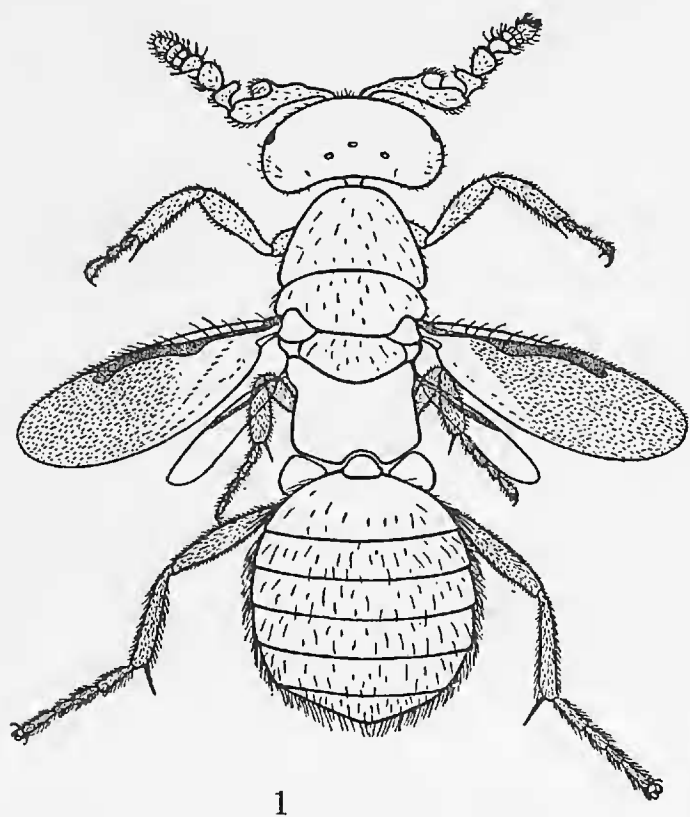


Fig. 1. Adult male. (Drawing by F. C. Hennessey.)

Fig. 2. Male antenna. (Drawing by F. C. Hennessey.)

Fig. 3. Adult female. (Drawing by F. C. Hennessey.)

Experiment (A): To rear generations of the insect to supply material for other experiments. One female chalcid was placed in a glass dish containing two naked mud-wasp grubs and one grub enclosed in its silken cocoon.

Experiment (B): To rear material and to determine if the mud-wasp grub enclosed in its cocoon would be attacked. One female chalcid was placed in a glass dish containing one naked mud-wasp grub and one grub enclosed in its silken cocoon.

Experiment (C): To watch pupation and emergence. One mud-wasp grub covered with well grown chalcid larvæ was placed in a glass dish.

Experiment (D): To observe pairing and oviposition. One mud-wasp grub was placed in a glass dish, and two male and six female chalcids, which had just emerged, were placed with it.

Experiment (E): To watch pupation and determine length of pupal period. Ten full-grown chalcid larvæ were placed each in a small glass vial.

Experiments (F) and (G): To see if eggs would be laid and adults produced from unfertilized eggs. In experiment (F), six female pupæ and in experiment (G) ten female pupæ were placed in two small glass dishes each with a mud-wasp grub.

Experiment (H): To observe the act of oviposition and to remove the eggs to determine the length of the egg stage. A fertile female chalcid was placed in a small glass dish with a mud-wasp grub.

LIFE HISTORY AND HABITS

Egg: The egg consists of a clear, jelly-like substance enclosed in a very thin, delicate, granular envelope. It is slightly curved, circular in cross section with hemispherical ends, about four and one-half times as long as broad, and larger at one end than at the other. Measurements indicate a length of .014 inch, a diameter at the larger end of .004 inch, and a diameter of .002 inch at the smaller end. No marked changes are visible during the egg stage, but the egg becomes slightly more opaque just before hatching. Out of 44 eggs kept under close observation 39 hatched in four days; the remaining five

eggs hatched in three days. Unfertilized eggs hatched in three days and invariably produced male chalcids.

The actual process of hatching was never observed, but freshly emerged larvæ were seen on several occasions with the cast egg skin remaining as a small shrivelled pellet close beside them.

Larva: The larva when first hatched grows rapidly and is twice the size of the egg in a few hours. At first it is a transparent shiny little grub with clearly defined segmentation. It is entirely without appendages and remains until full grown practically motionless upon the body of the mud-wasp grub with its mouth parts applied to the body of the host, sucking out its juices. There appear to be no moults. A full-grown larva measures .07 inch in length and .02 inch in greatest diameter. The larval stage lasts from eleven days for males to fifteen days for females. When full grown the larva loses its bright shiny appearance and becomes a dead white color, and a number of fat globules are visible under its integument. At this time the larva usually loosens its hold on its host and rolls off to one side. The food within the body of the larva now loses its moisture, turns from greenish yellow to a dark brown or almost black, and collects in a dry mass in the posterior half of the alimentary canal. Shortly after it is ejected slowly in a long dry string of frass pellets. This string of dry frass is often three times as long as the larva and usually remains sticking to the anal end even after pupation has taken place.

Larvæ under observation showed signs of pupation two days after all the frass had been ejected from the body, and on the third day pupation took place. During the process of pupation the larva becomes extremely soft and ruptures at the least touch of the skin. The head, legs and wings gradually become blocked out beneath the delicate skin, which is then shed and the pupa soon hardens.

Pupa: The pupæ are completely naked, without any kind of cocoon or protective covering, and lie about in all positions amongst the long strings of dry frass. At first they are completely white, but distinct color changes take place before emergence. The first change to be noted is that the tips of the mandibles turn brown. Then the eyes and ocelli become pink,

later turning a deep crimson red. As the pupal period proceeds, the whole of the mandibles turn brown and the body of the pupa turns yellow, then gray, and finally, a few days before emergence, a deep shining black. From a large number of observations it was found that these color changes were very constant and took place as follows: Mandibles: Tips brown in one to three days, entirely brown in thirteen to fifteen days. Eyes: Tinged with red in three to five days, deep crimson red in six to nine days. Body: Turns yellowish in five to six days, turns gray in fifteen to seventeen days, and turns deep shining black in sixteen to eighteen days.

The pupal stage for a large number of females and a few males was carefully recorded. The females were in the pupal stage for eighteen days and the males for seven days.

When the adult is ready to emerge, its pupal skin becomes very soft and sticky and easily tears when stretched. The pupa, lying on its back, struggles weakly, and expands and contracts its body. After a little while its legs and antennæ, encased in their pupal membrane, gradually free themselves from the thorax. The pupal wings rapidly expand and unfold, while the legs work themselves free. The pupal skin now breaks up into patches over the thorax and abdomen and is pushed backward in sticky patches by the legs. First the fore legs, then the middle legs, and finally the hind legs take up the task of ridding the chalcid of its pupal skin. At last the skin is pushed away by the hind legs and the adult wings are expanded. The adult now struggles to turn over on to its feet. Soon it succeeds in doing so, and commences to make a final clean up of its body, pushing off the remaining patches of skin with its legs. The skin of the antennæ and the head capsule are pushed off in one piece by the front legs; the pupal wing cases also come off in one piece and do not tear up as does the skin on the thorax and abdomen. The emergence takes about five minutes. When fully emerged, the adult spends some time rubbing its legs together, smoothing down its wings, and in generally cleaning up.

Adult: The female is a small black chalcid, one-tenth of an inch in length. It has well formed wings which overlap, one on the top of the other, flat along its back. The ovipositor,

which is provided with a short triangular serrated tip, lies, when not in use, in a groove on the ventral surface of the abdomen. The ovipositor measures .023 inch in length, .001 inch in width, with a serrated tip of .002 inch.

The male is broad, more stoutly built, and of a reddish brown color instead of black. The head is large and the compound eyes and ocelli minute. The antennæ are very curious appendages in the male. They are provided with a clasper which is used while pairing, and the terminal portion is very sensitive and evidently makes up for the poorly developed compound eyes. The wings are small rounded stumps which are carried erect over the thorax when the male is in motion, and are quite useless for flight.

The period from oviposition to the adult stage varies considerably according to the sex. From a number of observations it was found that this period for males was twenty-one days; with three days in the egg stage, eleven days as a larva, and seven days as a pupa. For females the total period was thirty-seven days; with four days in the egg stage, fifteen days as a larva, and seven days as a pupa. The females produced greatly outnumbered the males.

The females, although fully winged, were never seen to fly, and could not be induced to do so. When teased they would hop about like fleas. They spend much time each day in carefully cleaning and grooming themselves, and readily free their bodies of any foreign material with their legs. The front legs will double back and clean the whole dorsal surface of the thorax and the head, while the hind pair clean the wings and abdomen. The legs are cleaned by rubbing them together after the manner of the house fly.

Fertile females, confined in a glass vial, quickly gnawed their way out through an inch of cork, all escaping through the one tunnel. Doubtless this is the method employed in escaping from the mud-wasp's cell.

The males are extremely pugnacious and fight fiercely with one another until one of them is killed. A dead male, or even a small piece of one, will be fiercely pounced upon by another male, and dragged around and thrown about with a great show of anger, like a terrier with a rat.

Many hours were spent by the writer watching these little chalcids through a binocular microscope as they went about their daily tasks on the surface of the comparatively enormous mud-wasp grub. They paid no attention to strong electric light turned upon them, and no cover was necessary over the small glass dish in which they were being kept as they never attempted to leave it.

When a male and some females were placed in one of the glass dishes with a fresh mud-wasp grub the females, after pairing, began to pay attention to the mud-wasp, which was, at this time, quite lively, and would roll about when touched. During the next few days the females were almost constantly upon the body of the grub, piercing it with their ovipositors and feeding upon the drop of juice which exudes when the ovipositor was withdrawn. It is believed that some paralyzing fluid was injected during this puncturing process, as the mud-wasp grub, enormous as it is in comparison to the chalcid, becomes quiescent and immobile within twenty-four hours. In this condition the mud-wasp grub remains until sucked almost completely dry by the mass of feeding larvæ. At last it dies and decays, but not before several generations of chalcids have been produced.

Extract from notes: At 5:18 p. m. a female was observed, with her ovipositor extended at right angles to her abdomen, pushing downwards at the skin of the grub beneath her. The grub's skin was dented in as if hard to penetrate, and the chalcid's ovipositor bent from side to side. At 5:20 p. m. the ovipositor entered, and the skin of the grub resumed its natural position. The chalcid, with antennæ waving and abdomen pulsating, had pushed hard on her ovipositor, which by 5:22 p. m. is in to the full extent. For nearly five minutes the chalcid remained quiet with her antennæ moving gently. At 5:27 the ovipositor began slowly to be withdrawn. This seemed to take considerable strength on the part of the chalcid, especially when the enlarged serrated tip is extracted, with slow straining movements, from the tough skin of the grub. By 5:30 p. m., the ovipositor having been withdrawn and folded back against her abdomen, the chalcid backed a little and began

to drink the drop of juice which had exuded from the puncture. This could be seen slowly decreasing as the chalcid drank with motionless antennæ and pulsating abdomen. By 5:32 p. m. the remains of the fluid had hardened into a small pellet of half dried juice, and drinking was no longer possible. The chalcid now placed her ovipositor near the same spot as if to drill for more juice, but did not do so. She backed and gnawed at the pellet with her jaws until it was loosened and could be masticated and swallowed. She then cleaned her jaws and legs and prepared again to drill for food, but did not do so, and after a final cleaning of jaws and legs she appeared satisfied and wandered away at 5:43 p. m.

After a day or two of feeding in the manner described, the abdomen becomes round and plump, and oviposition soon commences.

The male chalcid is very attentive to the females, and, as soon as they emerge, will be found continually passing from one female to another, crawling upon them and rapidly clasping and unclasping the female's antennæ with his curious antennal claspers. This is usually repeated many times before copulation, which lasts about three seconds, takes place. The males take no food, and, after pairing with the females, soon die.

The females begin to lay their eggs soon after pairing. The eggs are laid on the surface of the mud-wasp grub, either singly or in little clumps. While laying eggs the chalcid stands on raised legs with her ovipositor pointing forward; its tip resting on the surface of the mud-wasp grub. When closely watched, it will be seen that the ovipositor splits along the ventral (now upper) surface, and the egg appears as a thin ribbon visible throughout the whole length of the ovipositor. The egg swells out suddenly from the lower third of the ovipositor into a large sausage-shaped object six times as thick as the ovipositor, and is soon completely free. The chalcid usually lays a number of eggs at a time, at the rate of two eggs per minute.

The mud-wasp grubs which were left in their tough cocoons remained alive and unharmed throughout these experiments,

the chalcids being unable to pierce these cocoons either for oviposition or feeding.

Two experiments were carried on to see if infertile eggs would hatch and produce adults. In each case a number of female pupæ were isolated and placed with a fresh mud-wasp grub. It was found that the chalcids laid very few eggs without pairing and all the eggs laid produced males. It is probable that in nature the males are produced from infertile eggs, laid by the females, in a similar manner to that employed by the honey bee.

No accurate information was obtained as to the number of eggs that one female would lay. They were evidently capable of laying a large number, as several hundred larvæ would be present on a mud-wasp grub at one time from eggs laid by two or three females. It was usual to remove the females after a few days or the food supply would not be sufficient to support the host of grubs produced.

As the early stages of this chalcid are passed in comparative safety within the mud cell of some solitary wasp or bee, they are very well sheltered from harm and no special protective devices are found. The adults, when they first emerge within the mud cell of a solitary wasp, are immune from enemy attack, and here presumably, pairing takes place. After pairing, the males probably die, while the females gnaw their way out of the mud cell to seek fresh food suitable for their larvæ.

From this point on the life-history as it would occur in nature can only be surmised.

The females, being fully winged but flightless, must depend on their legs in their search for fresh hosts. Possibly the wasp or bee's cell is entered before it is closed by the parent insect, and the chalcid may lay its eggs on the food supply of spiders or larvæ of various kinds which were intended for the larva of the host, thus starving the rightful owner. On the other hand, the chalcid may gnaw its way into the wasp's cell through the mud wall and lay its eggs upon the grub within after it has become large enough to support the chalcid larvæ. These are points which the laboratory experiments failed to clear up and which must be left unsolved by the writer at the present time.